

ATTACHMENT-11

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Mr. Tom Robinson
Director of Operations and Product Development
Barnhardt Manufacturing
1100 Hawthorne Lane
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Delivered by Email

Reference: Response to EPA Information Request Dated 5/14/2020

Dear Tom:

The following discussion addresses information requested by EPA in their letter dated 5/13/2020 from Karen McGuire, Director of Compliance Assurance Division. Items specifically addressed include those presented in Attachment B Section 4.b regarding a schedule for additional toxicity identification work and Section 4.c.ii, 4.c.iii, and 4.c.iv regarding wastewater treatment plant (WWTP) operations with only one aeration basin in service.

Biological Process Consideration

Based on the O&M manual, the WWTP average design flow capacity is 1.3 mgd. However, the plant is currently operating at only 25% of its capacity with an average flow of 0.33 mgd. The volume of each aeration basin is around 1.65 MG providing an average hydraulic retention time (HRT) of 10 days with both basins in service. The typical HRT for textile WWTP, using the extended aeration process, is 2 days or less. Due to the high HRT, when operating at a solids retention time (SRT) of around 30+ days, the current organic loadings are not sufficient to maintain a mixed liquor suspended solids (MLSS) concentration above 2,000 milligrams per liter (mg/L). The SRT is the main process control variable that maintains the food to mass ratio (F:M) for the system. This controls the solid production rate or sludge yield. For a given organic loading, the SRT and F:M control the amount of sludge produced and the mass of sludge in the system. Since the mass of sludge in the system is controlled by the SRT, the biomass concentration or MLSS is proportional to the volume of the system which includes the volume of the aeration basins and clarifiers in operation. Thus, the excessive volume of the system with both aeration basins in operation results in dilution of the sludge mass and low MLSS concentrations. Operating at MLSS concentrations below 2,000 mg/L are of concern with respect to poor bio-flocculation and increased levels of dispersed solids in the clarifier effluent. Given the excessive HRT with both basins in operation, the South Aeration Basin was taken out of service on 8/27/2018 in an effort to increase the MLSS concentration above 2,000 mg/L and to enhance solids flocculation and settleability.

The process performance with respect to chemical oxygen demand (COD) and biological oxygen demand (BOD) removal is controlled by the SRT. At a given SRT, the system is expected to operate similarly at different HRT values. The MLSS concentration for a given SRT and F:M will be proportional to the HRT. Thus, reducing the volume of the system by 50% will double the MLSS concentration at a given SRT. Using SRT process control, the minimum HRT is largely determined by the MLSS concentration and the resulting clarifier solids loading capacity. The allowable solids loading is a function of the settleability of the sludge which establishes the clarifier sludge flux rate (pounds per square foot per hour [lbs/ft²/hour]). The flux rate varies based on the sludge characteristic and typically ranges between 0.2 and 1.0 lbs/ft²/hour. Assuming clarifier solids loading rate of 0.5 lbs/ft²/hour and the existing clarifier surface area of 2,500 ft², the allowable solids loading rate for the clarifiers is around 30,000 lbs/day. At the current average flow, this would be equivalent to a MLSS concentration of over 10,000 mg/L. This is well above the current average MLSS concentration of 1,400 mg/L. Thus, operating at a reduce HRT has not resulted in excessive clarifier solids loading.

While the minimum MLSS is not typically a design consideration, the target MLSS is usually between 2,000 and 5,000 mg/L for extended aeration systems. Over the last 12 months, the WWTP has operated with an average SRT of 35 days and a F:M (based on BOD₅) of 0.06. The SRT is relatively high but was targeted to increase the mass of solids in the system and to maintain a high organic removal efficiency. The F:M was low but was within the typical range for extended aeration of 0.04 to 0.1 and would be expected at the high SRT. As noted above, the current MLSS concentration averaged 1,400 mg/L operating with only one aeration basin under current flow and loading conditions. If the system were being operated with two aeration basins in service, the MLSS would be diluted to 823 mg/L. Thus, operations with only one aeration basin does not detrimentally affect the biomass concentration and the higher MLSS should provide improved flocculation and lower dispersed solids in the effluent.

Operating Performance

Table 1 summarizes operating performance for the previous 12 months. The effluent COD averaged 202 mg/L with the effluent BOD₅ averaging 5 mg/L. Removal efficiencies for COD and BOD were 88% and 99%, respectively. Comparison of the effluent COD and BOD₅ concentrations indicates that biodegradable material was removed with a non-biodegradable fraction, represented by the effluent soluble COD, averaging 192 mg/L. The effluent TSS averaged 19 mg/L. These values indicate that the WWTP operated at a high efficiency level with respect to removal of biodegradable materials.

The current chronic No Observed Effect Concentration (NOEC) toxicity limit is $\geq 5\%$ and will increase to $\geq 7.2\%$ in 2021. For comparison purposes, the IC₂₅ values for the 6 quarters prior to operating with a single basin and the six quarters after are shown in the Figure 1 below. Based on a t-test analysis of the data, there was no significant difference in the mean IC₂₅ concentrations before and after changing the system to operate in a single aeration basin ($p = 0.90$). While statistically there is no significant differences, comparison is difficult due to the limited number of samples.

In addition, many variables other than the number of aeration basins in operation may have affected the toxicity. These variables include flow, chemicals and procedures used in manufacturing, and cotton characteristics.

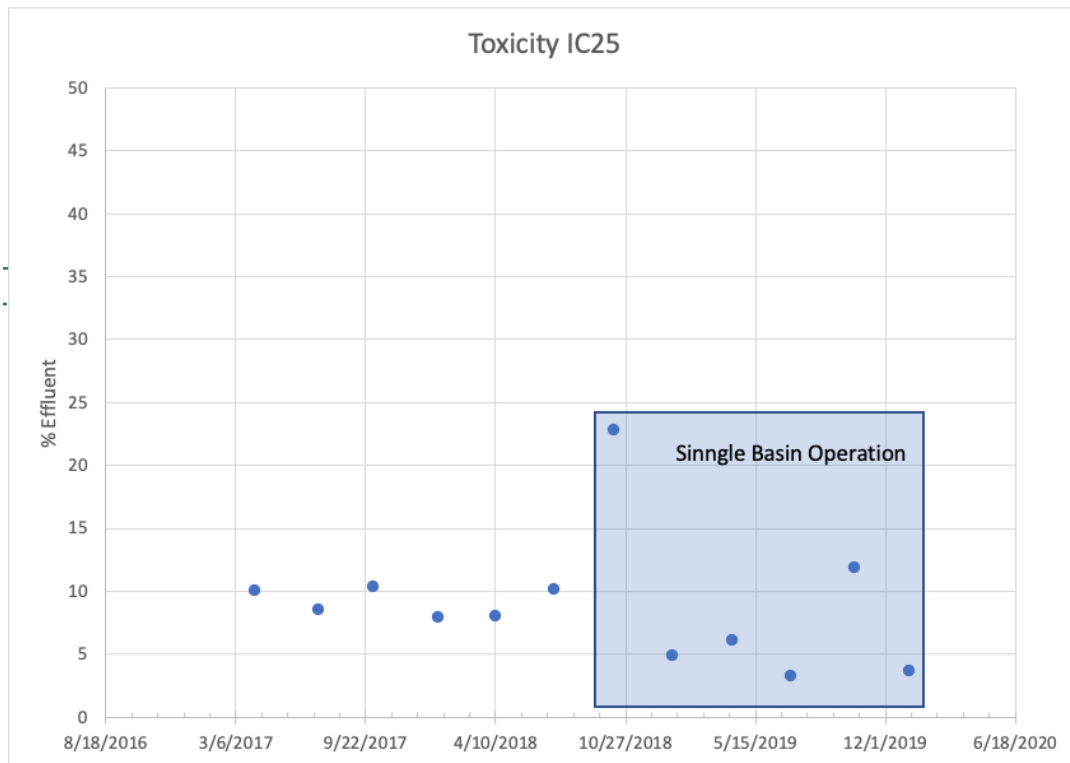
**Table 1. Summary of Average Values for Operating Parameter
for the period of 4/16/2019 through 4/15/2020**

Parameter	Units	Value
Flow	mgd	0.33
COD	mg/L	1734
COD	lbs/d	4175
Eff. COD	mg/L	202
Eff. Soluble COD	mg/L	192
Eff. COD	lbs/d	498
COD Removal	%	88%
BOD	mg/L	416
BOD	lbs/d	1157
Eff. BOD	mg/L	5
Eff. BOD	lbs/d	16
BOD Removal	%	99%
Eff. TSS	mg/L	19
MLSS	mg/L	1469
MLVSS	mg/L	1256
HRT, Aeration Basin	days	5.0
SRT	days	35
F:M COD		0.19
F:M BOD		0.06

Toxicity is an on-going concern for BMC and testing is being performed in an effort to identify the cause. Chronic toxicity tests were performed in December 2019 following various treatments to identify the class of contaminants contributing to the observed effluent toxicity. The treatments provided were:

1. Filtration with 0.45micron (μm) filter to remove colloidal materials;
2. Ethylenediaminetetraacetic acid (EDTA) treatment to chelate copper and other metals;
3. Activated carbon treatment to remove organics and other adsorbable material; and
4. Chemical coagulation to remove organics and colloidal materials.

Figure 1. WWTP Effluent IC₂₅ Values before and during Single Aeration Basin Operation



The use of these treatments did not suggest any significant improvement in acute or chronic toxicity. This indicates that carbon adsorbable organics, metals or colloidal materials are not major contributors to the observed toxicity. It is noted that the COD following chemical treatment and carbon adsorption at a dosage of 2,000 mg/L remained around 100 mg/L. Thus, a significant amount of organics remained in solution. These organics may be associated with toxicants and the possibility that trace level toxicants are present is being investigated. The toxicants may be due to contaminants on the cotton or by-products from the biodegradation of contaminants and/or process chemicals. One possibility is the presence of herbicides and/or pesticides used in cotton growing. A list of chemicals typically used has been compiled and ingredients that are known to be toxic to macroinvertebrates have been identified. Several degradation byproducts have also been identified. Proposals are currently being solicited from labs to perform analyses for these chemicals as well as general screening tests for organochlorine and organophosphate compounds. Once a lab has been selected, testing is expected to be performed on scour liquors from cotton baths, WWTP influent, and WWTP effluent. The actual testing that will be performed will be based on conclusions from on-going work as well as consultation with the testing laboratories.

To investigate the presence of toxicants originating from the cotton, samples of organically grown cotton, and conventional cotton were scoured using hot water only and the water samples were tested for acute toxicity.

Final results are not currently available, however preliminary results show that both samples exhibited acute toxicity to *Ceriodaphnia dubia*. Additional work is being performed to identify the toxicants present.

Additionally, chemicals used in BMC's manufacturing processes have been evaluated. One of the scouring agents historically used by BMC was identified as having a high concentration of aromatic organic compounds. BMC has replaced this chemical with an alternative having a lower concentration of aromatic compounds and toxicity testing has been performed on the WWTP effluent sampled after this chemical substitution. Test results did not show a significant improvement in toxicity.

Another area of investigation relates to the combined effects of low hardness and high total dissolved solids (TDS) on toxicity. It has been shown that under low hardness conditions, salts, such as sodium chloride and sodium sulfate, can be toxic to macroinvertebrates such as *Ceriodaphnia dubia* at relatively low concentrations. The hardness of the North River water, which is used for toxicity test dilution water, is typically around 30 mg/L and the TDS of the effluent averages around 1,500 mg/L. Thus, the low river water hardness and high wastewater salt concentrations may be contributing to the toxicity, especially at high effluent concentrations. Testing is being performed to determine if toxicity improves with the addition of calcium to increase the hardness. If so, the ionic constituents in the wastewater will be determined and testing of synthetic wastewater with a similar ionic balance may be tested to confirm toxicity associated with inorganic constituents.

If it is determined that recalcitrant organics are contributing to toxicity, the use of advanced oxidation methods such as ozonation may provide oxidation of these organic and/or improve their biodegradability. Ozonation of the WWTP influent and effluent is also being considered based on the results of on-going studies.

As described above, BMC has been working proactively to identify the cause(s) of non-compliant toxicity observations reported since issuance of the current NPDES permit. Results from a number of the studies are pending and should be completed within the next few months. Based on the current status of the work, the schedule presented in Table 2 is projected for completion of on-going evaluations and development of a plan of action for additional work.

The progress to date has been hindered by Covid-19 restrictions which may also impact BMC's ability to meet the proposed dates shown above.

To determine the operational performance with respect to total nitrogen (TN), the period of 9/1/18 through 5/20/20 was evaluated. The influent and effluent total nitrogen for this period are shown in Figure 2. The average total nitrogen concentrations before and after initiation of single basin operation are shown in Table 3. There was no statistical difference in the influent TN values before and after initiation of single basin operation ($p=0.59$). However, the average TN concentration while operating with a single basin was significantly lower ($p=0.008$).

Table II. Projected Schedule for Additional Toxicity Identification Work	Expect Completion Date
1. Complete work in progress including: a. Calcium addition trials; b. Toxicity testing of cotton hot water scour liquor; and c. Evaluation of WWTP effluent toxicity following scour chemical change.	6/30/2020
2. Determine the concentrations of pesticides and herbicides commonly used for cotton growing as well as known degradation by-products for: a. Organic cotton scour liquor; b. Conventional cotton scour liquor; c. WWTP influent; and d. WWTP effluent.	7/31/2020
3. Conduct additional pH and Alkalinity testing for impacts on toxicity.	8/31/2020
4. Compile results from all testing performed to identify toxicants and present report.	9/15/2020
5. Develop a plan of action for additional testing to identify toxicants and to achieve permit compliance.	9/30/2020

Figure 2. Total Nitrogen

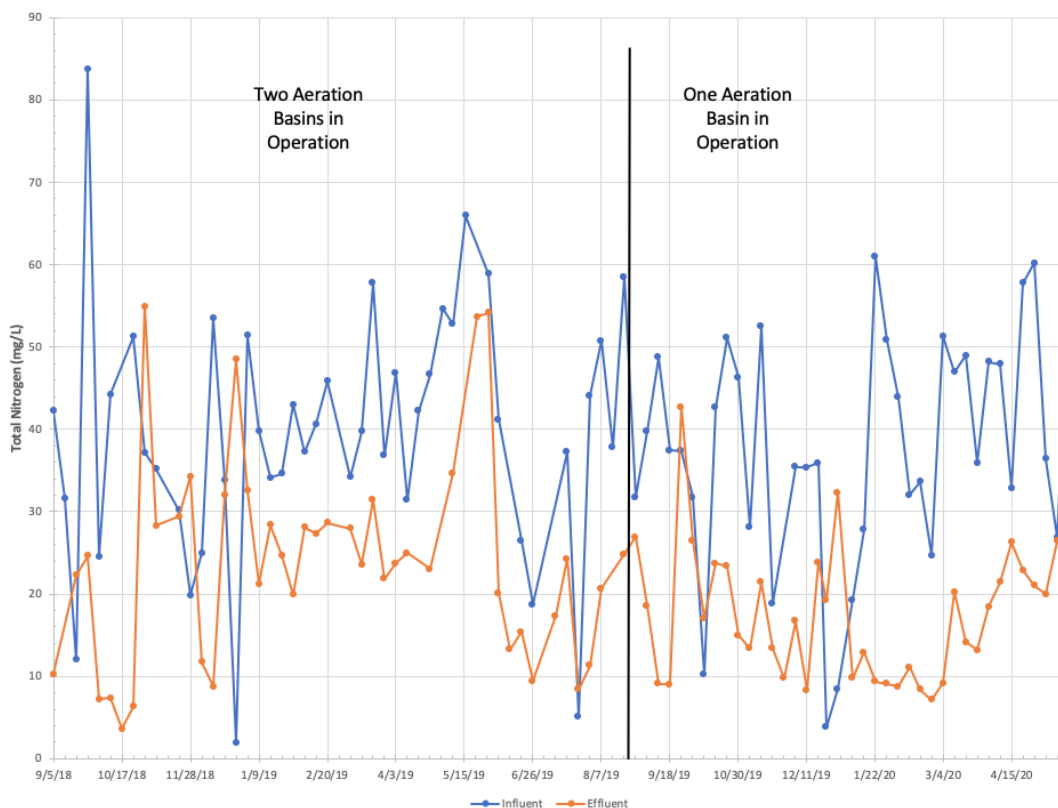


Table 3. Average Total Nitrogen (mg/L)

	Influent	Effluent
Two Basins	39.6	23.8
One Basin	37.8	17.6

In summary, the modification to the flow regime to provide single basin operation was made to enhance performance and there is no indication that operating with one aeration basin adversely affected the WWTP performance with respect to compliance with the NPDES permit. Though the aeration basin volume in operation was reduced by 50 percent, the current flow is only 33% of the design capacity. Thus, the aeration basin hydraulic capacity was within the process design criteria.

Sincerely,



W. Gilbert O'Neal, Ph.D., P.E
President